Single-Photon Lasercom Readout Integrated Circuit (ROIC), Phase II

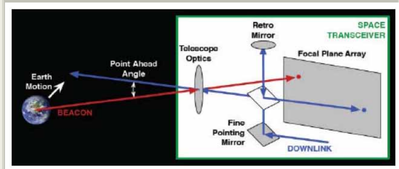
Completed Technology Project (2016 - 2019)

Project Introduction

To satisfy NASA?s deep-space communications needs, a 128 x 128-element readout integrated circuit (ROIC) will be developed for integration with Geiger-mode (Gm) avalanche photodiode (APD) detector arrays. The ROIC features integrated imaging, background subtraction, and time-resolved (sub-nanosecond) photon-counting functionality. The ROIC, when integrated with InGaAs Gm-APD arrays, will enable acquisition, tracking, and ranging of the 1064 nm ? 1570 nm optical radiation used in free-space optical links. This ROIC development will enable the manufacture of highly functional single-photon focal-plane arrays, offering the capability to reduce laser beacon power 100 times over analog optical detector arrays. In Phase II, the ROIC design will be completed, fabricated using a domestic CMOS process, and fully tested and characterized using a detector array. It will allow, in subsequent program phases, InGaAs Gm-APD focal-plane arrays to be fabricated.

Anticipated Benefits

The primary focus of this effort is the development of a custom photon counting ROIC design for space optical communications. NASA?s Space The primary focus of this effort is the development of a custom photon-counting ROIC technology for use in space optical communications. NASA?s Space Communications and Navigation Program Office identified optical communications as an important technology for NASA missions, allowing enhanced volume and quality of data returned from the farthest reaches of space to be achieved in preparation for future human deep-space exploration missions. Although several missions have validated optical communications from low-Earth and geostationary orbit, the unique challenges of deep-space optical links still require separate risk-retiring technology demonstrations before implementing inner-orbit communication. The innovation will also enable a variety of other low-light-level and time-resolved imaging applications?including lunar and planetary hazard-avoidance and landing systems, automated rendezvous and docking in space, and in situ instrumentation.Time-resolved ROICs are at the core of optical communication and laser detection and ranging (LADAR) systems. On Earth, free-space optical communication transceivers are required to enable reliable two-way datalinks. Increased functionality in LADAR receivers enables adaptive cruise control, surveillance, restricted-area event alerts, object identification, day-night-rain-fog imaging, aviation takeoff and landing, mid-air refueling, terrain mapping, autonomous navigation, smart-intersection monitoring and control, unmanned ground vehicles, unmanned air systems and vehicles, machine vision, hazard material detection and handling, and underwater 3D imaging.



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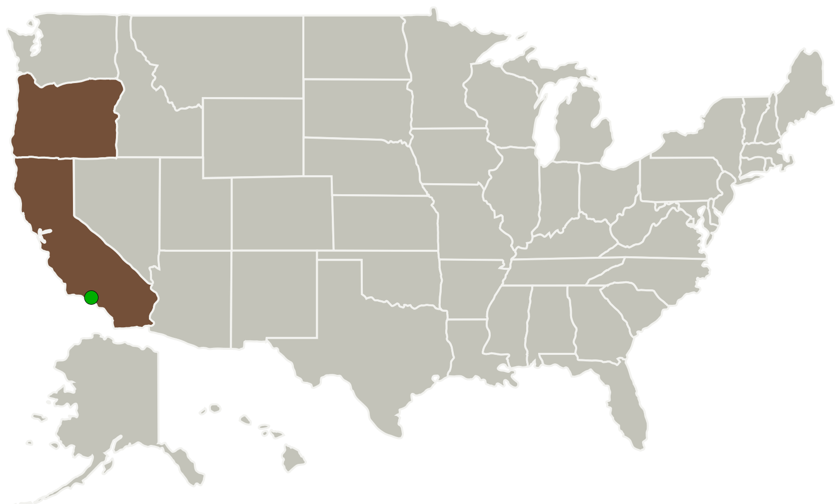
Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
Voxtel, Inc.	Lead Organization	Industry	Beaverton, Oregon
Jet Propulsion Laboratory(JPL)	Supporting Organization	NASA Center	Pasadena, California

Primary U.S. Work Locations	
California	Oregon

Project Transitions

May 2016: Project Start

May 2019: Closed out

Closeout Documentation:
- Final Summary Chart*(https://techport.nasa.gov/file/139641)*

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

Voxtel, Inc.

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

Carlos Torrez

Project Managers:

Robert A Jones
Carol R Lewis

Principal Investigator:

Adam Lee

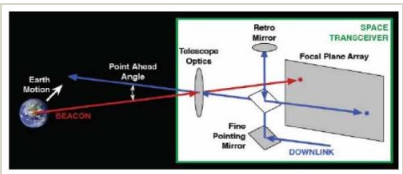
Co-Investigator:

Adam J Lee

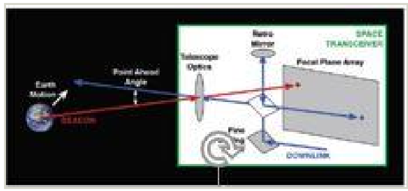
May 2019: Closed out

Closeout Documentation:
- Final Summary Chart PDF*(https://techport.nasa.gov/file/139642)*

Images



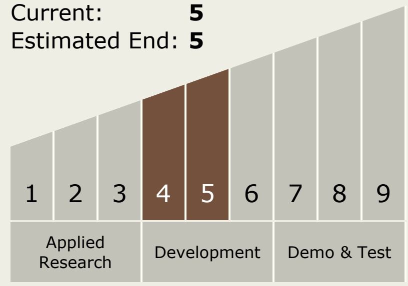
Briefing Chart Image
Single-photon Lasercom Readout Integrated Circuit (ROIC), Phase II *(https://techport.nasa.gov/image/136177)*



Final Summary Chart Image
Single-Photon Lasercom Readout Integrated Circuit (ROIC), Phase II *(https://techport.nasa.gov/image/135969)*

Technology Maturity (TRL)

Start: **4**
Current: **5**
Estimated End: **5**



Target Destinations

The Moon, Mars, Outside the Solar System, The Sun, Earth, Others Inside the Solar System